

18 and a lower driving end drivingly connected to the [pumping member to drive]
19 shielding means, [the pumping member] to rotate the pumping member in said
20 path of motion when the power device is actuated;
21 the shaft having a first coefficient of thermal expansion and
22 the shielding means having a different coefficient of thermal expansion; [and]
23 the shaft being telescopically disposed in the shielding
24 means out of contact with the molten metal, and forming a chamber between the
25 shaft and the shielding means sufficient to permit thermal expansion of the shaft
26 without imposing a radial thermal stress on the shielding means; and
27 means connecting the shielding means to the shaft such that
28 the shielding means and all internal components disposed therein rotate as a unit
29 with the shaft.

✓
In claim 7, line 3, change "pump housing" to --- pumping member ---.

1 In claim 10, lines 2-3, change "pump housing" to --- pumping member ---
2 and in line 10, insert ---a /--- before "structure".

✓
In claim 11, lines 3-4, change "pump housing" to --- pumping member ---.

✓
In claim 12, line 1, change "11" to --- 69 ---.

✓
In claim 13, line 1, change "11" to --- 69 ---.

✓
In claim 14, line 1, change "11" to --- 69 ---.

1 " 16. (Twice Amended) A combination, comprising:

2 pot means for containing a bath of molten metal;

a pumping member adapted to be disposed in a bath of a heated molten metal, and to move a stream of molten metal as the pumping member is driven in a path of motion;

a housing at least partially enclosing the pumping member;

a shielding means carried on the pump housing, the shielding means having an internal shaft-receiving opening;

a power device adapted to be supported above the bath of molten metal, and to be actuated in a powered motion;

means for connecting the power device to the pumping member to move the pumping member in said path of motion, comprising;

a pumping shaft having an upper end connected to the power device so as to be moved when the power device is actuated, and a lower driving end connected to the pumping member to drive the pumping member in said path of motion when the power device is actuated;

the driving end of the shaft having a first coefficient of thermal expansion and the [socket] shielding means having a different coefficient of thermal expansion; [and]

the shaft being disposed in the shielding means out of contact with the molten metal, and forming a chamber between the shaft and the shielding means sufficient to permit thermal expansion of the shaft without imposing a radial thermal stress on the shielding means; and

24 means connecting the shielding means to the shaft such that
25 the shielding means and all internal components disposed therein rotate as a unit
26 with the shaft.

1 ¹²
 18. (Twice Amended) Apparatus for moving a stream of molten metal
2 in a bath of the molten metal comprising:

3 a pumping member adapted to be disposed in a bath of a
4 heated molten metal, and to move a stream of the molten metal as the pumping
5 member is driven in a path of motion;

6 a power device adapted to be supported above the bath of
7 molten metal, and to be actuated in a powered motion;

8 means for connecting the power device to the pumping
9 member to move the pumping member in said path of motion, comprising;

10 a pumping shaft adapted to be connected to the power
11 device to be rotated thereby;

12 a tubular shield means (50) of a heat resistant material
13 telescopically receiving the shaft and having a length longer than the [shield
14 means] shaft (24) so that the lower end of the shield means extends beyond the
15 lower end of the shaft;

16 [means connecting the shaft to the shield means to rotate
17 the shaft and the shield means together; and]

18 means connecting the shield means to the pumping member
19 to rotate the shield means and the pumping member together; and

20 means connecting the shield means to the shaft such that
21 the shield means and all internal components disposed therein rotate as a unit
22 with the shaft.

In claim 25, line 3, change “pump housing” to --- pumping member ---, and in line 5, after “thereto” insert ---, ---.

1 ²⁰
26. (Twice Amended) Apparatus as defined in claim ¹²~~18~~, including a
 [^]
2 pump housing at least partially enclosing the pumping member, and in which the
3 shield means includes:

4 an outer tubular shield having a lower end attached to the

5 [pump] pumping shaft;

6 an inner tubular shield telescopically disposed in said outer
7 tubular shield and being cemented thereto;

8 the inner tubular shield having a bore with a diameter greater
9 than the diameter of the pumping shaft, and enclosing the pumping shaft so as to
10 form a chamber therearound;

11 the lower end of the inner tubular shield being spaced from
12 the lower end of the outer tubular shield to form a shoulder;

13 a structure disposed adjacent the lower end of the drive
14 shaft having a diameter greater than the diameter of the bore of the inner tubular
15 shield but less than the diameter of the outer shield, and the structure engages

16 the shoulder to locate the lower end of the shaft with respect to the shield means;
17 and
18 cement disposed in the lower end of the outer tubular shield
19 with a socket accommodating the configuration of the lower end of the shaft but
20 having a clearance therebetween to accommodate the relative thermal
21 expansion characteristics of said [structure and the cement in the socket] shaft
22 lower end but permitting the shaft lower end to be rotated with the socket to
23 rotate the pumping member.

In claim 27, line 1, change "26" to --- 71 ---.

In claim 28, line 1, change "26" to --- 71 ---.

1 ³⁴46. (Amended) An apparatus for moving a stream of molten metal
2 comprising:
3 a pumping member;
4 a housing at least partially enclosing the pumping member;
5 a power device; [and]
6 a shaft connecting the power device and the pumping
7 member to rotate same, said shaft having an elongated drive element; [and] an
8 elongated shield assembly [, the shield assembly] surrounding[,] and forming a
9 space between the drive element and the shield assembly sufficient to permit
10 thermal expansion of the drive element; and

11 means connecting the shield assembly to the shaft such that
12 the shield assembly and all internal components disposed therein rotate as a unit
13 with the shaft.

In claim 53, line 1, change "52" to --- 72 ---.

1 ⁴¹55. (Amended) The apparatus as defined in claim ³⁴~~46~~, in which the
2 shield assembly comprises:
3 an outer tubular shield having a lower end adjacent the
4 housing,
5 an inner tubular shield telescopically disposed in said outer
6 tubular shield and attached thereto;
7 the inner tubular shield having a bore with a diameter greater
8 than the diameter of the drive element, and enclosing the drive element to form a
9 chamber therearound;
10 a tongue extending from said drive element outside of said
11 inner tubular shield;
12 [one or both of] said inner tubular shield [or] and said tongue
13 being secured to said outer shield; and
14 said outer shield being secured to said pumping member.

In claim 56, line 1, change "55" to --- 72 ---.

In claim 64, line 1, change "63" to --- 74 ---.

Please add the following new claims:

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69. Apparatus for moving a stream of molten metal in a bath of the
molten metal comprising:

a pumping member adapted to be disposed in a bath of a
heated molten metal, and to move a stream of the molten metal as the pumping
member is driven in a path of motion;

a housing at least partially enclosing the pumping member;

a shielding means carried on the pump housing, the
shielding means having an internal shaft-receiving opening;

a power device adapted to be supported above the bath of
molten metal, and to be actuated in a powered motion;

means for connecting the power device to the pumping
member to move the pumping member in said path of motion, comprising;

a rotatable pumping shaft having an upper end connected to
the power device so as to be moved when the power device is actuated, and a
lower driving end connected to the pumping member to drive the pumping
member in said path of motion when the power device is actuated;

the shaft having a first coefficient of thermal expansion and
the shielding means having a different coefficient of thermal expansion;

the shaft being telescopically disposed in the shielding
means out of contact with the molten metal, and forming a chamber between the
shaft and the shielding means sufficient to permit thermal expansion of the shaft
without imposing a radial thermal stress on the shielding means;

the shielding means comprising an elongated tubular shield telescopically enclosing the pumping shaft, the tubular shield having a lower end attached to the pumping member, and an upper end, the tubular shield having a length such that the upper end is disposed above the metal surface of the bath of molten metal; the tubular shield including:

an outer tubular shield having a lower end attached to the pumping member;

an inner tubular shield telescopically disposed in said outer tubular shield and being attached thereto;

the inner tubular shield having a bore with a diameter greater than the diameter of the shaft, and enclosing the shaft so as to form said chamber therearound;

the lower end of the inner tubular shield being spaced from the lower end of the outer tubular shield to form a driving chamber;

a driving structure supported on the lower end of the shaft enclosed within the outer tubular shield; and

cement disposed in the outer tubular shield having a socket accommodating the configuration of said driving structure, the driving structure being disposed in said socket but having a clearance therebetween to accommodate the relative thermal expansion characteristics of said driving structure and the socket, but permitting the driving structure to be rotated to engage the socket in the cement to rotate the pumping member.

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~~70~~. Apparatus for moving a stream of molten metal in a bath of the
molten metal comprising:

a pumping member adapted to be disposed in a bath of a
heated molten metal, and to move a stream of the molten metal as the pumping
member is driven in a path of motion;

a power device adapted to be supported above the bath of
molten metal, and to be actuated in a powered motion;

means for connecting the power device to the pumping
member to move the pumping member in said path of motion, comprising;

a shaft adapted to be connected to the power device to be
rotated thereby;

a tubular shield means of a heat-resistant material
telescopically receiving the shaft and having a length longer than the shaft so
that the lower end of the shield means extends beyond the lower end of the
shaft;

means connecting the shaft to the shield means to rotate the
shaft and the shield means together;

means connecting the shield means to the pumping member
to rotate the shield means and the pumping member together;

a pump housing at least partially enclosing the pumping
member;

and in which the tubular shield means includes an outer
tubular shield having a lower end attached to the pumping member; and

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24 an inner tubular shield telescopically disposed in said outer
25 tubular shield and being cemented thereto.

1 ²⁵
24. Apparatus for moving a stream of molten metal in a bath of the
2 molten metal, comprising:

3 a pumping member adapted to be disposed in a bath of a
4 heated molten metal, and to move a stream of the molten metal as the pumping
5 member is driven in a path of motion;

6 a power device adapted to be supported above the bath of
7 molten metal, and to be actuated in a powered motion;

8 means for connecting the power device to the pumping
9 member to move the pumping member in said path of motion, comprising;

10 a shaft adapted to be connected to the power device to be
11 rotated thereby;

12 a tubular shield means of a heat-resistant material
13 telescopically receiving the shaft and having a length longer than the shaft so
14 that the lower end of the shield means extends beyond the lower end of the
15 shaft;

16 means connecting the shaft to the shield means to rotate the
17 shaft and the shield means together;

18 means connecting the shield means to the pumping member
19 to rotate the shield means and the pumping member together;

a pump housing at last partially enclosing the pumping member, and in which the tubular shield means includes:

an outer tubular shield having a lower end attached to the shaft;

an inner tubular shield telescopically disposed in said outer tubular shield and being cemented thereto;

the inner tubular shield having a bore with a diameter greater than the diameter of the shaft, and enclosing the shaft so as to form a chamber therearound;

the lower end of the inner tubular member being spaced from the lower end of the outer tubular member to form a shoulder;

a structure disposed adjacent the lower end of the shaft having a diameter greater than the diameter of the bore of the inner tubular shield but less than the diameter of the outer shield, the structure engaging the shoulder to locate the lower end of the shaft with respect to the tubular shield means; and

cement disposed in the lower end of the outer tubular shield with a socket accommodating the configuration of the lower end of the shaft but having a clearance therebetween to accommodate the relative thermal expansion characteristics of said shaft lower end, but permitting the shaft lower end to be rotated in the socket to rotate the pumping member.

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72. An apparatus for moving a stream of molten metal, comprising:
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2 a pumping member;
3 a housing at least partially enclosing the pumping member;
4 a power device;
5 a shaft connecting the power device and the pumping
6 member, said shaft having an elongated drive element and an elongated shield
7 assembly, the shield assembly surrounding, and forming a space between the
8 drive element and the shield assembly sufficient to permit thermal expansion of
9 the drive element;
10 the shield assembly further comprising inner and outer
11 telescoping shield members; and
12 the drive element including a shoulder adjacent a pumping
13 member end, and the inner shield member abuts said shoulder.

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73. 1 An apparatus for moving a stream of molten metal comprising:
2 a pumping member;
3 a housing at least partially enclosing the pumping member;
4 a power device;
5 a shaft connecting the power device and the pumping
6 member, said shaft having an elongated drive element and an elongated shield
7 assembly, the shield assembly surrounding, and forming a space between the
8 drive element and the shield assembly sufficient to permit thermal expansion of
9 the drive element; and

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10 including at least one post supporting said power device
11 above said housing;
12 said post including an annular groove;
13 said housing including a socket having a cooperative annular
14 groove; and
15 a retaining element positioned in said grooves.

1 ³²
74. An apparatus for moving a stream of molten metal comprising:
2 a pumping member;
3 a housing at least partially enclosing the pumping member;
4 a power device;
5 a shaft connecting the power device and the pumping
6 member, said shaft having an elongated drive element and an elongated shield
7 assembly, the shield assembly surrounding, and forming a space between the
8 drive element and the shield assembly sufficient to permit thermal expansion of
9 the drive element;
10 a post supporting said power device above said housing;
11 said post having a leg portion and a shield portion of heat-
12 resistant material surrounding said leg portion; and
13 an inner diameter of said shield portion being greater than
14 the outer diameter of said leg portion.

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1 Apparatus for moving a stream of molten metal in a bath of the
2 molten metal comprising:

3 a pumping member adapted to be disposed in a bath of a
4 heated molten metal, and to move a stream of the molten metal as the pumping
5 member is driven in a path of motion;

6 a housing at least partially enclosing the pumping member;

7 a shielding means carried on the pump housing, the
8 shielding means having an internal shaft-receiving opening;

9 a power device adapted to be supported above the bath of
10 molten metal, and to be actuated in a powered motion;

11 means for connecting the power device to the pumping
12 member to move the pumping member in said path of motion, comprising;

13 a pumping shaft having an upper end connected to the
14 power device so as to be moved when the power device is actuated, and a lower
15 driving end connected to the pumping member to drive the pumping member in
16 said path of motion when the power device is actuated;

17 the shaft having a first coefficient of thermal expansion and
18 the shielding means having a different coefficient of thermal expansion;

19 the shaft being telescopically disposed in the shielding
20 means out of contact with the molten metal, and forming a chamber between the
21 shaft and the shielding means sufficient to permit thermal expansion of the shaft
22 without imposing a radial thermal stress on the shielding means;

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the shield means comprising an elongated tubular shield telescopically enclosing the pumping shaft, the tubular shield having a lower end attached to the pumping member, and an upper end, the tubular shield having a length such that the upper end is disposed above the metal surface of the bath of molten metal;

the tubular shield means including:

an outer tubular shield having a lower end attached to the pumping member;

an inner tubular shield telescopically disposed in said outer tubular shield and being attached thereto;

the inner tubular shield having a bore with a diameter greater than the diameter of the shaft, and enclosing the shaft so as to form a chamber therearound;

the lower end of the inner tubular shield being spaced from the lower end of the outer tubular shield to form a driving chamber;

a driving structure supported on the lower end of the shaft enclosed within the outer tubular shield; and

cement disposed in the outer shield having a socket accommodating the configuration of said driving structure, the driving structure being disposed in said socket but having a clearance therebetween to accommodate the relative thermal expansion characteristics of said driving structure and the socket, but permitting the driving structure to be rotated to engage the socket in the cement to rotate the pumping member;

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the clearance between the driving structure and the socket
being formed by the steps of:

forming the outer tubular shield with a lower blind end;
disposing cement in the blind end of the outer tubular shield
to form a socket having the configuration similar to but larger than that of the
driving structure;

disposing a wax that turns to a gas when exposed to the
heat in the bath of molten metal, in said socket;

disposing the driving structure in the wax; and

telescopically inserting the inner tubular shield in the outer
tubular shield to engage the driving structure, and cementing the inner tubular
shield to the outer tubular shield to form a unitary tubular shield around the
pumping shaft.

⁵³
76. Apparatus for moving a stream of molten metal in a bath of the
molten metal comprising:

a pumping member adapted to be disposed in a bath of a
heated molten metal, and to move a stream of the molten metal as the pumping
member is driven in a path of motion;

a power device adapted to be supported above the bath of
molten metal, and to be actuated in a powered motion;

means for connecting the power device to the pumping
member to move the pumping member in said path of motion, comprising;

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a shaft adapted to be connected to the power device to be rotated thereby;

a tubular shield means of a heat-resistant material telescopically receiving the shaft and having a length longer than the shaft so that the lower end of the shield means extends beyond the lower end of the shaft;

means connecting the shaft to the shield means to rotate the shaft and the shield means together;

means connecting the shield means to the pumping member to rotate the shield means and the pumping member together;

a pump housing at least partially enclosing the pumping member, and in which the tubular shield means includes:

an outer tubular shield having a lower end connected to the shaft;

an inner tubular shield telescopically disposed in said outer tubular shield and being cemented thereto;

the inner tubular shield having a bore with a diameter greater than the diameter of the shaft, and enclosing the shaft so as to form a chamber therearound;

the lower end of the inner tubular shield being spaced from the lower end of the outer tubular shield to form a shoulder;

a structure disposed adjacent the lower end of the shaft having a diameter greater than the diameter of the bore of the inner tubular

shield but less than the diameter of the outer shield, the structure engaging the shoulder to locate the lower end of the shaft with respect to the tubular shield means;

cement disposed in the lower end of the outer tubular shield with a socket accommodating the configuration of the lower end of the shaft but having a clearance therebetween to accommodate the relative thermal expansion characteristics of said shaft lower end, but permitting the shaft to be rotated in the socket to rotate the pumping member;

the clearance between the lower end of the shaft and the socket being formed by the steps of:

forming the outer tubular shield with a lower blind end;

disposing a cement in the blind end of the outer tubular shield to form a socket having the configuration similar to but larger than that of said shaft lower end;

disposing a wax that turns to gas when exposed to the heat
in the bath of molten metal in said socket:

disposing said structure in the wax;

inserting the inner tubular member into the outer tubular shield so as to engage said structure; and

cementing the inner tubular shield to the outer tubular shield
to form a unitary tubular shield around the shaft.

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1 An apparatus for moving a stream of molten metal, comprising:

2 a pumping member;

3 a housing at least partially enclosing the pumping member;

4 a power device;

5 a shaft connecting the power device and the pumping
6 member, said shaft having an elongated drive element and an elongated shield
7 assembly, the shield assembly surrounding, and forming a space between the
8 drive element and the shield assembly sufficient to permit thermal expansion of
9 the drive element;

10 the shield assembly comprising:

11 an outer tubular shield having a lower end adjacent
12 the housing;

13 an inner tubular shield telescopically disposed in said
14 outer tubular shield and attached thereto;

15 the inner tubular shield having a bore with a diameter
16 greater than the diameter of the drive element, and enclosing the drive element
17 to form a chamber therearound;

18 a tongue extending from said drive element outside of
19 said inner tubular shield;

20 said inner tubular shield and said tongue being
21 secured to said outer shield, and

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22 said outer shield being secured to said pumping
23 member.

1 ⁵⁵78. The apparatus as defined in claim ⁵⁴77, in which a clearance is
2 provided between the tongue and the outer shield by the steps of:
3 forming the outer tubular shield with a lower blind end;
4 disposing a cement in the blind end of the outer tubular
5 shield to form a socket having the configuration similar to but larger than that of
6 the drive element;
7 disposing a wax that turns to gas when exposed to the heat
8 in a bath of molten metal, in said socket;
9 positioning the drive element in the wax, and
10 telescopically inserting the inner tubular shield in the outer
11 tubular shield to engage the drive element, and cementing the inner tubular
12 shield to the outer tubular shield to form a unitary shield around the shaft.

REMARKS

Claims 1, 3-7, 9-16, 18-28, and 46-65 remain in the case for consideration.

Claim 18 was rejected under 35 U.S.C. 112 as being indefinite for failing to point out and distinctly claim the subject matter that Applicant regards as his invention.